

REMARKS

Applicant respectfully requests reconsideration and allowance in view of the foregoing amendments and following remarks. In the Office Action, dated May 11, 2004, the Examiner rejected claims 1-20. By this amendment, Claim 16 has been amended to more clearly set forth aspects of the invention. Following entry of this amendment, claims 1-20 will be pending in the application.

Claim Rejections under 35 U.S.C. §103(a)

In the Office Action, the Examiner rejected claims 1-20 under 35 U.S.C. §103(a) as allegedly being unpatentable over U.S. Patent No. 6,145,007 to Dokic et al. (hereinafter "Dokic"). Applicant respectfully traverses the rejections of claims 1-20 and notes for subsequent reference the following standards for a proper §103(a) rejection.

A rejection based on §103(a) (obviousness) is proper only when "the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which the subject matter pertains." 35 U.S.C. §103(a). The Examiner must make out a *prima facie* case for obviousness. The mere fact that references can be combined or modified is not sufficient to establish *prima facie* obviousness. The *en banc* Federal Circuit has held that "structural similarity between claimed and prior art subject matter, proved by combining references or otherwise, where the prior art gives reason or motivation to make the claimed compositions, creates a *prima facie* case of obviousness." *In re Dillon*, 16 U.S.P.Q. 2d 1897, 1901 (CAFC 1990). The underlying inquiries into the validity of an obviousness rejection are: "(1) the scope and content of the prior art; (2) the level of ordinary skill in the prior art; (3)

the differences between the claimed invention and the prior art; and (4) objective evidence of nonobviousness.” *In re Dembiczak*, 175 F.3d 994, 998, (Fed. Cir. 1999).

Further, the mere fact that references can be combined or modified does not render the resultant combination obvious unless the prior art also suggests the desirability of the combination. *In re Mills*, 916 F.2d 680, 16 U.S.P.Q.2d 1430 (Fed. Cir. 1990). Likewise, if the proposed modification would render the prior art invention being modified unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed modification. *In re Gordon*, 733 F.2d 900, 221 U.S.P.Q. 1125 (Fed. Cir. 1984).

Additionally, with hindsight, a claim of obviousness can be an easy one to make. Many inventions seem obvious with the clarity of 20-20 hindsight. However, a hindsight basis for obviousness is inappropriate and cannot sustain a *prima facie* case of obviousness. Applicant’s respectfully assert that the Examiner is judging obviousness of Applicant’s invention using hindsight, and as such, should reconsider the rejections from the proper perspective of the time of Applicant’s invention, without the teachings of Applicant’s disclosure.

Finally, Applicant respectfully reminds the Examiner of the following: the proposed modification cannot render the prior art unsatisfactory for its intended use; and the proposed modification cannot change the principle of operation of a reference.

For at least the reasons stated below, Applicant asserts that Dokic fails to describe or suggest the subject matter as a whole of Applicant’s claimed invention and, therefore, that Applicant’s rejected claims 1-20 are patentably distinct from Dokic.

Independent Claim 1 and 17

Applicant respectfully disagrees with the Examiner's rejection of Claims 1 and 17 for at least the following reasons:

First, Dokic does not disclose "a first register associated with a first processor" nor "a second register associated with a second processor" as claimed by the Examiner. The cited passage in the summary is silent on association between registers and processors. Further, Dokic requires that both processors have read-write access to the same registers and rely on "software discipline and management" to prevent conflicts (col. 10, lines 35-61).

In contrast, the present invention discloses register sets that are associated with each respective processor. For example, at p. 9, lines 1-14, specific detail is provided of an exemplary embodiment wherein each processor (CPU or COP) has an associated, dedicated inbox and an associated, dedicated outbox. Even with hindsight, a reading of the Dokic reference cannot be viewed as rendering obvious the present invention because, as Dokic states: "Obviously, in this case both DSPs have to have both write and read access to the same physical register" (col. 10, lines 54-56). Thus, Dokic teaches away from the present invention and each and every element as set forth in claims 1 and 17 are not found in Dokic.

Second and with respect, Applicant disagrees with the Examiner's belief that Dokic discloses or suggests "a semaphore unit for indicating the status of the shared resources in the system and for notifying the first and second processors of a particular task to be executed..." The cited Dokic passages clearly state that, in both modes described, Dokic's alleged semaphores are set and cleared by software (col. 9, line 49 to col. 10 line 6; and col. 10 line 35 to col 11 line 15). Dokic specifically requires software executed by each of the processors to poll the alleged semaphores in order to determine state of a shared resource. Additionally, the

software is required by Dokic to set or clear the alleged semaphores in order to signal state of the shared resource (*Id.*). Further, Dokic states that semaphore management is to be handled with software discipline and management (*See* col. 10 lines 59-61).

Applicant observes that notification requires “giving notice” or “pointing out” and concludes that Dokic discloses no semaphore unit that notifies. (*See e.g.* Merriam-Webster Online Dictionary). The Dokic reference relies on software executed by a processor to poll the alleged Dokic semaphores. In dokic, it is the software executed by the respective processors that notify. Therefore, it is clear that the Dokic reference does not teach a semaphore unit “notifying the first and second processors.”

Applicant directs Examiner to the latency problem of Dokic, solved in the present invention, as an indication of the failure of the Dokic reference to provide or anticipate the notifying semaphores of the present invention (*See* Examiner’s citations of Claim 3 *infra*). Specifically, Dokic speaks of checking semaphores at 1 ms intervals to obtain minimum latency in processing commands (col. 15 lines 43-55). This latency, therefore, is a direct result of the selections made by the programmer and derives from the software implementation disclosed by Dokic.

In contrast, the present invention provides a semaphore unit used in combination with hardware semaphore registers permits task sharing without latency (*See* claim 3 and page 3 at lines 8-10). Clearly then, the present invention is not anticipated by Dokic and cannot be considered obvious when Dokic places significant emphasis on encouraging “software discipline” to prevent conflict and regular polling to minimize latency. Since the present invention provides a hardware solution to resolve both of these problems in Dokic, it should be apparent that Claims 1 and 17 are patentable over Dokic.

Third, and concerning the obviousness of providing two registers, Applicant directs the Examiner's attention to the prior discussion of this claim in reminding Examiner that the disclosed registers provide inbox and outbox functionality associated with each processor. Further the operation of the inbox and outbox are controlled by hardware-implemented semaphores. The ability to multiply register sets and association of register sets through software choice does not render the present invention any more obvious.

Finally, Applicant observes that any conversion of Dokic's software semaphore scheme or change in the operation of Dokic's sets of registers would amount to a modification that changes the principle of operation of the Dokic reference. Such a change in principles of operation prevents a finding of obviousness. Therefore, the Examiner should allow independent Claims 1 and 17 and all claims depending from Claim 1 or from Claim 17.

Dependent Claim 2

Regarding the combination of processor and coprocessor: as discussed previously, Dokic processes semaphores and interprocessor communications through software. Dokic requires the polling of the semaphore registers by software executed on the processors. Applicant observes that, under Dokic, a coprocessor with limited capabilities may be unable to consistently poll the software semaphores and would suffer increased latencies as a result. Examples of coprocessor limited capability may include available processing cycles, overhead associated with processing bulk data or complex algorithms, limits on interrupt capacity, etc.

In contrast, the present invention discloses hardware implementations of semaphore management that notify processors of the need for processor action with no latency. Consequently, the present invention provides zero-latency capabilities and is less susceptible to

coprocessor limitations than Dokic. Thus, Claim 2 is allowable over Dokic.

Dependent Claim 3

As discussed previously, Dokic declares that latency can be minimized by frequent polling at, for example, 1 ms intervals. However, it will be appreciated that the software solution disclosed by Dokic cannot consistently achieve zero latency. Because the present invention resolves the latency problem and provides zero latency, Claim 3 is allowable over Dokic.

Dependent Claim 4

As discussed previously, Dokic does not provide association between registers and processors. Nor does Dokic disclose notification of processors by a semaphore unit. Because the present invention provides both association and notification, Claim 4 is allowable over Dokic.

Dependent Claims 5 and 6

The Examiner cites Dokic as providing an interrupt to an associated processor when a message is received from the semaphore unit and clearing the interrupt by reading from an associated mailbox. Respectfully, Dokic does not disclose such an interrupt generation sequence. In fact, in the cited passage, Dokic discloses that the semaphore register is polled by software executed by the processors and, upon reading a satisfactory semaphore state, a register is written that *may* cause an interrupt to one of the processors. Dokic does not disclose interrupts generated by mailboxes. Therefore, the Claims 5 and 6 are allowable over Dokic.

Dependent Claims 7 and 19

The Examiner equates the setting and clearing of a flag in Dokic with the communication of an acknowledge notification of the present invention. However, in the specification of the present invention, "the mailbox 70a, 70b generates an acknowledge signal to notify the other processor 12, 14,..." (p9, lines 3-7). Thus, Dokic does not disclose the advantageous action of the mailbox and instead relies on software executed by the processors to actively participate in the communication process by, for example "setting the flag and clearing the flag" (col. 01 lines 35-61). Dokic does not anticipate nor suggest the elements of Claims 7 and 19 and, therefore, Applicant respectfully request allowance of Claims 7 and 19.

Dependent Claims 8 and 20

The Examiner correctly points to the use of semaphore registers in Dokic. However, the semaphore registers and their use, as described in the cited reference, implement principles of operation that lead to problems solved by the present invention. The present invention, as discussed previously, provides a solution to the problems of the conventional semaphore method adopted by Dokic and the the resulting hardware innovations of the present invention provide automatic conflict resolution in preemptive multitasking systems and provide for simpler implementations of cooperative multitasking. Because the present invention resolves problems that cannot be resolved by Dokic, Claims 8 and 20 should be allowed.

Dependent Claim 9

The Examiner suggests that the Dokic semaphore register is a semaphore controller. Applicant respectfully disagrees. Dokic clearly states that the semaphore register and activities

related to, and using semaphores are controlled by software (col. 10, lines 35-61).

In contrast, the current invention uses a set of hardware semaphore registers and a semaphore unit for controlling the operation of the semaphore registers (*see* P. 3, lines 14-24). Therefore, because Dokic implements a software semaphore method and the present invention utilizes hardware semaphore registers and a semaphore controller, Dokic lacks an essential element of Claim 9. Thus, Claim 9 should be allowed.

Dependent Claims 10-12

The Dokic passages cited by the Examiner provide no basis for rendering Claims 10-12 obvious. Dokic does not provide for hardware semaphore registers, associating bits in hardware registers with shared resources nor the setting and resetting of bits in a hardware register. Applicant agrees that setting of bits in a registry is a programmer's choice and does not constitute a patentable limitation, but Applicant respectfully reminds the Examiner that hardware semaphore registers are provided by the present invention. Because the hardware semaphore register of the present invention cannot be characterized as the software registers of Dokic, Applicant asserts that "programmer's choice" is not relevant. Therefore, Applicant requests allowance of Claims 10-12.

Dependent Claim 13

Respectfully, Applicant observes that the cited reference concerning ping-pong strategy is not directly relevant in the context of Claim 13. Claim 13 provides the allocation of bits in semaphore registers and association of the bits with system resources. Because Dokic does not provide allocation and association of bits in hardware semaphore registers, Claim 13 should be

allowed.

Dependent Claims 14 and 15

Dokic does not teach nor suggest hardware registers (as discussed previously). Consequently, the the operation and use of hardware registers to facilitate inter-process communication is not disclosed nor suggested by Dokic. Therefore, Claims 14 and 15 should be allowed.

Independent Claims 16

Applicant respectfully disagrees that Dokic teaches preemption. In one cited passage, Dokic speaks of the use of Trap instructions for the purpose of debugging. Although Dokic characterizes the well-known and commonly used Trap technique as “basically [allowing] a pre-planned interruption of the current task” (col. 8, lines 39-46). The Trap technique places a Trap software instruction at a location in a program as chosen by the programmer (*Id.*). If the processor encounters the Trap instruction, then a high priority interrupt is executed (*Id.*). It is clear that the Dokic Trap interrupt may never occur (i.e., if the instruction is not encountered). Further, the application described in Dokic is directed at debug techniques rather than creating a periodic interruption.

In contrast the present invention provides for interruption of a processor when a mailbox has become full, causing the processor to stop processing work in progress and handle the information in the mailbox (P. 8, line28 – P. 9, line 14). Thus, the executing task is preempted by interprocessor communications to handle any interprocessor messages. Because the Dokic time-slicing possibility does not disclose or suggest the notification mechanisms of the present

invention, Claim 16 should be allowed.

Dependent Claim 17

The Office Action does not set forth an independent basis for rejecting Claim 17. To the extent that the Examiner relies on commonality with Claim 1, the rejection is traversed for the reasons presented in response to the rejection of Claim 1.

Dependent Claim 18

The cited Dokic references discuss interrupts generated by programmable timers and used for a debug interface. Dokic does not discuss notification of the processor using interrupts. Therefore, Applicant requests allowance of Claim 18.

Dependent Claim 19

The Office Action does not set forth an independent basis for rejecting Claim 19. To the extent that the Examiner relies on commonality with Claim 7, the rejection is traversed for the reasons presented in response to the rejection of Claim 7.

Dependent Claim 20

The Office Action does not set forth an independent basis for rejecting Claim 20. To the extent that the Examiner relies on commonality with Claim 8, the rejection is traversed for the reasons presented in response to the rejection of Claim 8.

Conclusion

For the reasons stated, and taking into consideration the standards for obviousness presented above, Applicant asserts that one of ordinary skill in the art would not have considered Applicant's invention obvious at the time of invention and, therefore, that Applicant's rejected Claims 1-20 are not obvious over the prior art of record.

Dokic does not resolve the problems of latency and conflict and adopts a significantly different approach than that disclosed in the present application. Indeed, Dokic concedes that communication conflicts are not eliminated by its teachings (col. 11, lines 20-27) and relies on "software discipline" to avoid conflicts in access (col. 10, lines 54-61; col. 15, lines 43-45; col. 11).

In contrast, the present invention teaches the "a shared mailbox architecture ... in combination with a set of hardware semaphore registers 68" for interprocess communications (page 8, 1-15). Through the use of hardware semaphores, the present invention removes dependency on Dokic's "software discipline" and thereby eliminates conflicts in access. The Examiner is directed to page 11, lines 17-28 et seq for an illustration of the interprocessor communication in accordance with the present invention.

Because the present invention solves at least the admitted problems associated with the Dokic reference, and because the present invention does not rely on Dokic's "software discipline," Applicant believes that all of the present claims are allowable over Dokic.

All objections and rejections having been addressed, it is respectfully submitted that the present application is in a condition of allowance and a Notice to that effect is earnestly solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

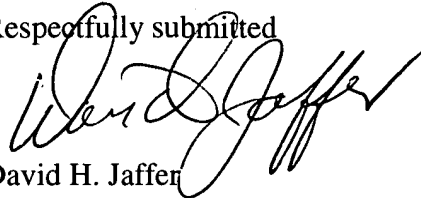
CONCLUSION

Applicant has explained the differences between the claims and the cited references, and believes the claims are in condition for allowance.

If any further questions should arise prior to a Notice of Allowance, the Examiner is invited to contact the attorney at the number set forth below.

Date: November 12, 2004

Respectfully submitted



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